No. 4.] [APRIL, 1877.

THE

MINERALOGICAL MAGAZINE

AND

JOURNAL

OF THE

Mineralogical Society

OF

GREAT BRITAIN & IRELAND

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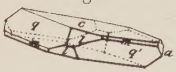
1877.

Fig. 1.



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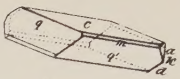

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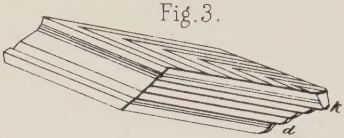

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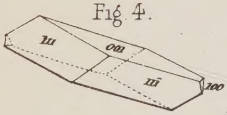

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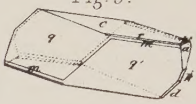

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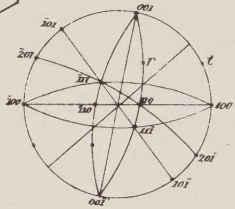

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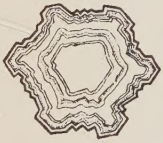

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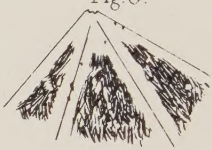

Fig. 9.

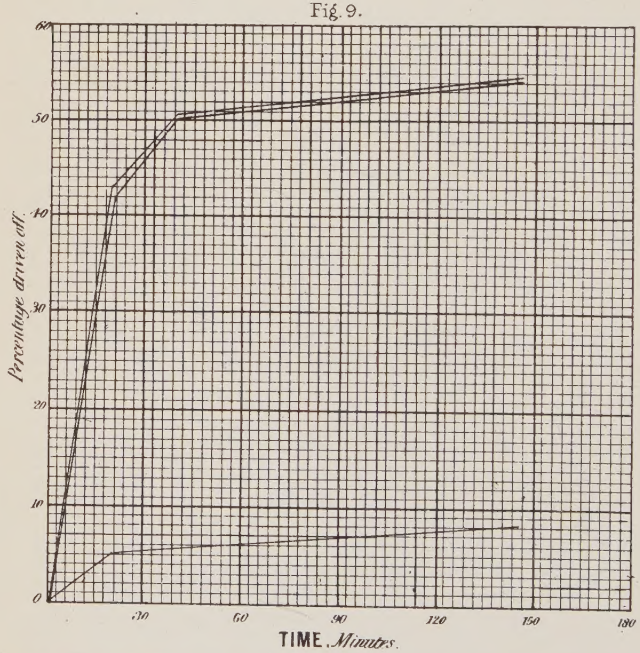

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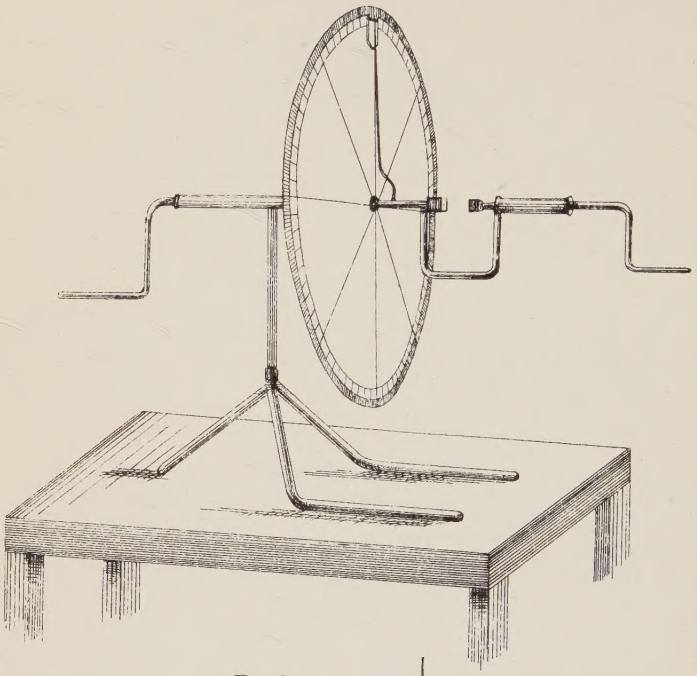
Fig. 1.



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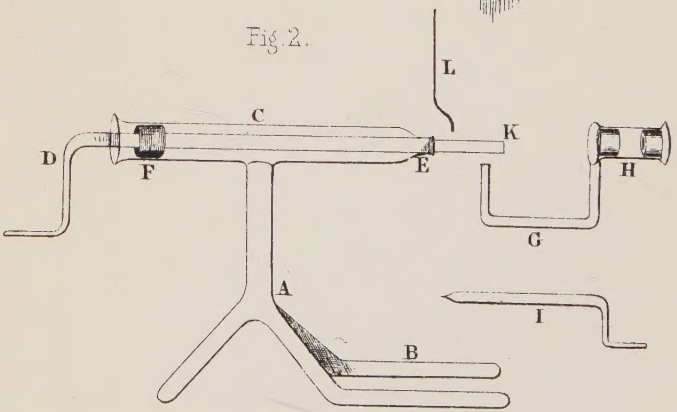

LAKE & LAKE TRURO.

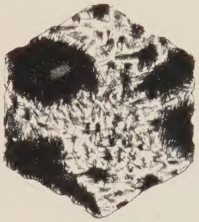

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Fig. 5.

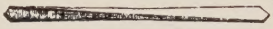

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Fig. 2. × 20.

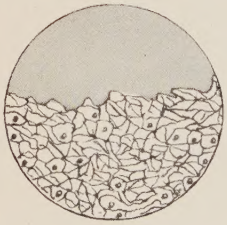
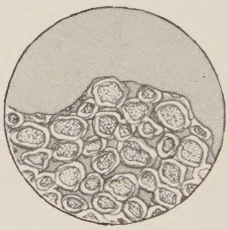


Fig. 6.

Fig. 4. × 250.



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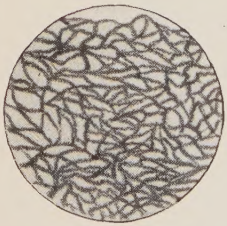

Fig. 9.

Fig. 10.

LAKE & LAKE, LITH. TRURO.

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MDCCCLXXVII.

EXCERPT MINUTES OF COUNCIL MEETING.

Held at King's College, London, on Wednesday, March 14th, 1877.

Mr. H. C. Sorby, F.R.S., *President*, in the chair.

Resolved—That the following gentlemen having been duly proposed in accordance with Rule V. be elected, viz. :—

MEMBERS.

The Rev. John G. Michie, Dinnet, Aberdeenshire.
Mr. C. H. Richards, Redruth, Cornwall.
Mr. W. Peters, Redruth, Cornwall.
Mr. J R. Daniell, Camborne, Cornwall.
Mr. Alfred G. Lock, F.R.G.S., Brixton, London, S.E.
Prof. A. H. Green, M.A., Yorkshire College of Science, Leeds.
Mr. John Davies Enys, F.G.S., Canterbury, New Zealand.

ASSOCIATES.

Mr. T. B. Provis, Camborne, Cornwall.
Mr. Wm. Hodge, Camborne, Cornwall.
Mr. Stephen Vivian, Mwyndy Llantrissant, Glamorganshire.
Mr. Solomon Birkett, Millom, Cumberland.

The following gentlemen were elected Corresponding Members, in accordance with Rule VI., viz. :—

Prof. James D. Dana, Newhaven, Conn., U.S.A.
Prof. P. Groth, Strasburg.
Prof. Henry How, D.C.L., Windsor, Nova Scotia.
Prof. L. Moissenet, Ecole des Mines, Paris.

GENERAL MEETING.

Held at the Rooms of the Royal Microscopical Society, King's College, London, on Wednesday, March 14th, 1877.

Mr. H. C. Sorby, F.R.S., *President*, in the chair.

The Chairman briefly described his new method of determining the refractive powers of transparent substances.

The following papers and notes were read, viz. :—

On a Serpentine from Japan, by Prof. A. H. Church, M.A.

On the Magnetic Constituents of Rocks and Minerals, by Mr. J. B. Hannay, F.C.S.

On an easily constructed form of reflecting Goniometer, by Mr. J. B. Hannay, F.C.S.

On a peculiar form of Quartz Crystal from Australia, by the Rev. J. M. Mello, F.G.S.

On Vauquelinite from Scotland and on Cantonite from Cornwall, by Mr. Thos. Davis, F.G.S.

On Quartz Crystals enclosing Tourmaline, from Boscaswell Downs, St. Just, Cornwall, by Mr. J. H. Collins, F.G.S.

On the Iron Oxides enclosed in quartz from the Mwyndy Iron Mines, Glamorganshire, by Mr. Wm. Vivian.

On the Hydrous constituent of Rocks and Minerals, by Mr. J. B. Hannay, F.C.S.

On Nordenskjold's Ice blocks, by H. J. V. Steenstrup; translated by F. G. Rohde.

Specimens in illustration of their papers and remarks were exhibited by Messrs. Sorby, Church, Davis, Mello, and Collins.

The following specimens were also exhibited:—

Ludlamite from Cornwall, by Mr H. Ludlam.

Pumice from Arkja or Oskja Gja, Iceland, by Mr. Thos. Davies.

Remarkable Octahedra of Iron from the interior of pigs of that metal, by Mr. Amos Beardsley.

Books Received.

From *Reale Comitato Geologico d' Italia.* Bolletino, Nos. 1 and 2, 1877.

,, *Mr. R. H. Scott.* Account of an expedition to Greenland in the year 1870, by Prof. A. E. Nordenskjold.

,, *Prof. P. Groth,* Strasburg. Zeitschrift fur Krystallographie und Mineralogie, Heft. 1 and 2.

,, *Prof. Jas. D. Dana.* American Journal of Science, Jan. to April, 1877.

STATEMENT OF RECEIPTS AND EXPENDITURE TO DECEMBER 31ST, 1876.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Composition Fees	105	0	0	By Formation Expenses to Feb. 4, 1876	11	18	7
" Entrance Fees and Subscriptions	75	5	0	" Attendants' Gratuities, and for clerical and other assistance	2	6	3
				" Stamps, Parcels, &c., Feb. 4th, to Dec. 31	5	16	5
				" Cheque Book	0	5	0
				" Secretary's Fare to Glasgow, for General Meeting	8	12	6
				" Lake, for Printing and Stationery	32	6	0
				" Copas, for Wood Engraving	0	10	0
				" Balance—Robarts, Lubbock, & Co.	89	4	9
				" Balance in hand	29	5	6
	£180	5	0		£180	5	0

Assets.				Liabilities.			
Balances as above	118	10	3	Printing and Stationery	14	12	0
Subscriptions considered good	30	0	0	Balance	133	18	3
	£148	10	3		£148	10	3

Examined, compared with the Vouchers, and found correct.

BENEDICT KITTO.
M. HAWKINS JOHNSON.

THE MINERALOGICAL MAGAZINE

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MINERALOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND.

No. 4. APRIL, 1877. Vol. 1.

I—*On a simple method for determining the index of refraction of small portions of Transparent Minerals.*

By H. C. Sorby, F.R.S., &c., *President.*

Preliminary Notice.

THE author exhibited and described the small additions that need be made to an ordinary microscope, in order to make it available for the above-named purpose, and also gave a few illustrations of its application to particular minerals. So far, however, the instrument has been used only sufficiently to prove that the method gives excellent results. The author thinks it desirable to defer a complete description of the construction and use of the instrument until he has been able to examine a sufficient number of minerals to publish a table of their indices of refraction for practical use. It may, however, be well to say that the addition to the microscope consists only in a small graduated scale attached to the body of the instrument, and vernier to read off to $\frac{1}{1000}$th of an inch. This enables us to measure the extent to which the focal length of the object glass is increased by looking through a more or less transparent mineral, and also its thickness in the part thus examined.

From these data the index of refraction can be calculated very easily by means of the formula $\mu = \frac{t}{t-d}$ where μ is the index of refraction, and d the increase in the length of the focus due to looking through the thickness t of the mineral. Since in different minerals the index of refraction varies from about 1·43 in fluor, to 3·28 in ruby silver, and the measurements are easily made, it will be seen that it is a most important character, which, up to the present time, has not been recognised in mineralogical works, on account of the difficulty of determining it by previous methods.

II.—*Analysis of a Serpentine from Japan.*

By A. H. Church, M.A., Oxon.

QUITE recently I obtained from an importation of Japanese curiosities two pairs of chop-sticks which were catalogued and sold as *jade*. Under this name are often included, not only the true jade or nephrite, with a hardness of 6 and a specific gravity approaching 3, but also three other mineral species. Of these *jadeite* is not only harder but heavier than jade: *prehnite* differs but slightly from jade in either of these characters; while *fluor*, the remaining species referred to, has a hardness of 4 only Had the specimens to which I now direct attention belonged to any of the foregoing species, they would have been worthy of notice on account of their extraordinary size, or rather length, and also by reason of the beauty of their appearance. But after I had determined these objects to be serpentine, I thought some particulars as to their characteristics might prove of service in identifying one of the materials employed in oriental art.

The specimens are no less than 10¼ inches in length. Their colour is of the faintest greyish yellow: their translucency is so considerable as almost to pass into transparency. The hardness of the specimens is 5, and the specific gravity 2·58 The following are the analytical results obtained in the chemical examination of this Japanese serpentine.

Placed *in vacuo* over sulphuric acid the powdered mineral showed a very trifling loss of moisture, doubtless hygroscopic—

·7454 gram lost ·0025 gram H_2O, or ·34 per cent.

Even at 100° C. or rather at the temperature of the water-oven, the water removed was but ½ a per cent. and cannot be regarded as essential—

1·0145 gram lost ·0055 gram H_2O or ·54 per cent.

On submitting the powdered mineral, after its weight had become constant in the water-oven, to a prolonged ignition, the result was—

(I).—1·009 gram lost ·123 gram, or 12·16 per cent.

The further analysis of the mineral was made in two ways. In one experiment, the decomposition of the serpentine was accomplished by the long-continued action of hydrochloric acid; in the other, the mineral was fused with the usual mixture of sodium and potassium carbonates. The following results were obtained—

(II).—*Acid Method.*—·743 gram gave ·3385 gram SiO_2; ·861 gram $Mg_2P_2O_7$; and ·0165 gram Al_2O_3 and Fe_2O_3.

(III).—*Fusion Method.*—·709 gram gave ·3205 gram SiO_2; ·8435 gram $Mg_2P_2O_7$; and ·017 gram Al_2O_3 & Fe_2O_3.

Disregarding the insignificant losses of water *in vacuo*, and at 100°, we may tabulate the above results thus—

	I.	II.	III.	
Silica	—	45·56	45·20	per cent.
Magnesia	—	41·75	42·86	,,
Alumina and ferric oxide	—	2·22	2·12	,,
Water	12.19	—	—	,,

Now these percentages agree fairly well with those demanded by the accepted formula of true serpentine, $3MgO, 2SiO_2, 2H_2O$; which are—

Silica	43·48 per cent.
Magnesia	43·48 ,,
Water	13·04 ,,

The divergences between these theoretical numbers and those furnished by experiment are easily explained, when we recollect the interference caused by the intrusion of the alumina and ferric oxide, and when we take into account the sources of error inseparable from analytical work: the slight deficiency of water may be due to the specimen having become heated during the process of polishing to which it had been submitted. Indeed, it is strange to note how wonderfully accordant all recent analyses of serpentine are with one another and with theory. It is especially strange when we recollect the physical state of this species and the nature of the minerals from which, in many instances, it must have been derived.

A word, in conclusion, concerning the state in which the water exists in this mineral. Rammelsberg has shown that exactly half the water in serpentine is easily disengaged at a comparatively low temperature, but that a considerable heat and a prolonged ignition are necessary in order to expel the remainder. This fact confirms that formula for this silicate, which other considerations support, namely—

$$\left.\begin{matrix}3MgO\\H_2O\end{matrix}\right\} 2SiO_2 + Aq.$$

III.—*On the Magnetic Constituents of Rocks and Minerals.*

By J. B. Hannay, F.R.S.E.

ALL minerals are supposed to be either magnetic or diamagnetic, and in a large number, exact measurements have been made of the relative amount of magnetic force in each mineral. As was to be expected, the compounds of Iron and Nickel are, in the great majority of cases, the cause of the magnetism in mineral; but there exists a large border land of slightly magnetic mineral substances, the cause of whose magnetism has never been very clearly shown. I do not intend, in this paper, to deal with those which are only faintly magnetic, but with those whose magnetism is quite distinct, such as Obsidian, Basalt, &c. The method used for testing the relative amount of magnetism in any specimen was as follows. A strong but light magnet was suspended from the hook above the pan of a delicate balance, (that in question turning with $\frac{1}{10}$ of a milligram when loaded with the magnet and counterpoise) and the mineral placed on a little table over the pan, a rack and pinion motion allowing the table to be raised or lowered quickly when wanted. The balance was left free to swing, and the mineral slowly raised till nearly touching the magnet, then if any deflection was noticed the table was lowered to obtain the greatest amount of angular inclination of the beam, which was then noted. If no deflection was caused, the beam was made to swing slightly, so as to make the pointer move one division to right and left of the zero point on the ivory scale, and, while the end with the magnet was at his highest point, the mineral was approached to it and lowered with it, following the swing of the balance, so that if magnetic, the mineral aided the swing. When the magnet was at its lowest point, the mineral was lowered about two inches from it, so that it might have no influence in retarding the upward motion of the beam. After repeating this operation several times, the increase in the swing was noted, and if sufficient,

the mineral was laid aside for examination. The question which I wished to answer was this:—are slightly magnetic rocks and minerals homogeneously magnetic, that is, slightly magnetic throughout their entire substance, or are they magnetic by virtue of small particles of magnetic substances interspersed throughout their substance. The principle consideration which led me to this investigation, was that, (putting aside magnetic iron ore), the purer and more homogeneous the mineral the less its magnetic power, and conversely the more mixed or impure the mineral the more magnetism did it display. On making careful analyses of those substances, which, not being very pure, showed a stronger magnetic condition than pure specimens, I found that in every case there was an excess of iron. The following estimations of iron in different specimens will, I think, show this. Column A shows the amount of iron in specimens slightly magnetic, and column B shows that in those more so.

ROCKS AND MINERALS.	A	B
Porphyry	2·86	4·29
Pyrochlore	1·25	3·67
Obsidian	1·82	3·26
Serpentine	0·85	3·43
Natrolite	0·18	1·65
Basalt	14·65	18·22
Pitch-stone	1·00	3·18
Rhodonite	0·65	6·28
Red Clay	1·55	3·67
Gneiss	0·08	2·26
Crystalline Lava from Herculaneum ..	6·18	7·04

Some specimens of these substances were reduced to powder in wedgewood and agate mortars, and from a portion of that powder (about 50 grammes) the magnetic particles were separated out. This process is exceedingly tedious, as it takes at least a day's work and sometimes more, to completely separate the purely magnetic portion.

The specific gravity of the original substance, of the demagnetized portion, and of the magnetic portion, were then determined, and analyses made of both the magnetic and non-magnetic portions. The following table represents the numbers so obtained for several substances whose examination I have been able to finish.

	Sp. Gr. of Mineral.	Demagnetical portion.	Magnetic portion.
Obsidian ..	2·668	2·625	3·295
Basalt	2·538	2·522	3·265
Pitch-stone ..	2·312	2·297	3·258
Serpentine ..	2·557	2·529	3·284
Lava	2·869	2·838	3·294
Gneiss	2·635	2·610	3·271

To show the necessity of having the minerals very finely pulverized, so as to obtain their real specific gravities, I may state that the lava, No. 5, on being pulverized as finely as is usual for analysis gave 2·820 as its Sp. Gr., when more finely pulverized it rose to 2·828, then 2·832, 2·835, 2·837 and 2·838, in this last case the pulverization being carried so far that the mineral, on being boiled with water in the Sp. Gr. bulb to expel adhering air, took an hour to settle sufficiently clear to render the bulb transparent. This shows clearly that in some instances at least there are small interstitial spaces which are generally neglected in taking a Sp. Gr. The amount of magnetic substance contained in these minerals varied from 0·3 to 1·7 per cent., and was determined directly by weighing the magnetic portion obtained from a known weight of the mineral.

The experimental numbers were checked by calculation, one method used being given in the following formula, which would show if any serious error had been committed in the separation or Sp. Gr. of the magnetic and non magnetic portions.

$$\frac{D}{100} = \frac{1}{\frac{x}{\Delta} + \frac{x'}{\Delta'}}$$

Where D = Density of the Original Mineral.
x = Percentage of Magnetic portion.
x' = ,, Nonmagnetic ,,
Δ = Density of Magnetic ,,
Δ' = ,, Nonmagnetic ,,

As the original density is easily obtained with great accuracy, by equating all those quantities in which error might be against it, we detect any serious mistake. Now the principal result obtained from these numbers is that the magnetic portions from widely different sources have practically the same Specific Gravity, and

that it is always higher than that of the original mineral. The rocks and minerals differ very much in composition, as the following analyses will show, but the magnetic constituents are remarkably alike.

	1	2	3	4	5	6
SiO_2	74·26	48·83	72·56	43·18	46·87	70·24
Fe_2O_3	3·25	13·97	2·25	3·27	7·04	3·00
FeO	——	2·56	0·87	0·04	——	——
Al_2O_3	11·48	18·25	13·44	0·19	35·42	16·40
MnO	——	——	——	0·43	0·04	——
CaO	2·93	6·53	1·78	0·73	0·14	0·77
MgO	0·85	2·88	4·27	40·30	3·87	0·05
$K_2O + Na_2O$	6·12	2·01	3·04	——	4·20	6.98
H_2O	1·01	5.82	1·99	12·07	1·85	1·84
	99·90	100·85	100·20	100·21	99·43	99·28

The above substances were those in which the excess of iron showed itself to be magnetic by trials against normal specimens by the method explained, and the following analyses show the composition of the magnetic constituent, when purified as much as possible from adhering mineral.

	1	2	3	4	5	6
Fe_3O_4	51·07	58·81	62·18	61·33	62·07	60·21
Fe_2O_3	3·04	2.82	1·05	1·84	0·25	1·85
MnO	——	——	——	0·09	——	——
SiO_2	40·82	36·57	36·22	35·73	36·28	36·88
Al_2O_3	5.01	2·12	0·82	1·05	1·30	1·28
	99·94	100·32	100·27	100·04	99·94	100·22

With the exception of the magnetic portion of the Obsidian No. 1, these figures show that the substance which causes the magnetism in the above minerals has the same composition, as in each case the numbers show a remarkable similarity, considering the difficulty in obtaining the substance pure. Even in the case of No. 1, it seems that the difference is caused chiefly by adhering Obsidian, as the excesses of silica and alumina occur almost in the proportion to form that mineral. The numbers agree pretty well with a body having the formula Fe_3O_4, 2 SiO_2 which requires 65·91 per cent. of magnetic oxide, and 34·09 of Silica. Supposing Silicic acid to be a tetra-basic acid, this would be a perfectly normal compound, just as we might have the salt $Fe_3(SO_4)_4$ or Fe_3O_4, 4 SO_3, so we have $Fe_3Si_2O_8$ or Fe_3O_4, 2 SiO_2.

It is rather curious that substances obtained from such widely different sources should yield magnetic particles of the same composition, (for, I think, the excess of silica may safely be attributed to adhering mineral), and further it is a significant fact that the more magnetic the substance the greater is the per centage of the magnetic constituents. This, I think, points to the conclusion that many of the minerals at present considered magnetic are not so by any magnetism inherent in their pure substance, but by reason of an intermixture of magnetic particles, and, as far as I have yet gone, I feel confident that many substances at present considered magnetic will require to be classed when pure as diamagnetic. I have not yet been able to determine, with any degree of certainty, the crystalline form of the magnetic constituent, because, as was to be expected, the pulverization of the mineral fractures the particles, and I have not been able to pick out a suitable crystal, but from some faces, and especially from one portion of a pyramid, as seen through the microscope, I am inclined to think the crystalline form of the mineral is hexagonal. I am making an extended examination of the subject, and shall be able, I hope, to get more conclusive results for publication in a future paper.

IV.—*Examination of the Hydrous Constituent in Minerals.*

By J. B. Hannay, F.R.S.E.

In a paper lately communicated to the Chemical Society, I endeavoured to show that an exact examination of the rate at which water was expelled from hydrated substances at any constant temperature, might teach us much as to the constitution of these bodies. One of the bodies examined was the mineral Gypsum, which has been found in three different states—first, in its most usual form as $Ca\,SO_4$, $2\,H_2O$, or as it should be written $2\,Ca\,SO_4$, $4\,H_2O$ as in selenite; second as $2\,Ca\,SO_4$, H_2O in which three of the molecules of water have disappeared, as in certain un-named forms of Anhydrite; and third as $Ca\,SO_4$ as in Anhydrite. Now these three can also be obtained by artificial means; the second being found in steam boilers where the water is evaporated under pressure; so I made several attempts to obtain the other two possible hydrates, $2\,Ca\,SO_4$, $3\,H_2O$, and $2\,Ca\,SO_4$, $2\,H_2O$ by evaporating solutions under different pressures, but I could obtain no satisfactory results.

In examining the dehydration of selenite, I noticed that the rate at which most of the water was driven off was nearly constant till the compound $2\,Ca\,SO_4$, H_2O was reached; but on plotting the numbers in a curve, it was seen that the rate at which the first molecule came off was greater than that of the other two; that is, that the decomposition $2\,Ca\,SO_4$, $4\,H_2O$—H_2O took place at a greater rate than $2\,Ca\,SO_4$, $3\,H_2O$—H_2O, pointing to the facts that the compound left by the first of these reactions really has an existence, but as the second and third molecules came off at the same rate, that is, there was no break in the straight line representing their evolution, the compound $2\,Ca\,SO_4$, $2\,H_2O$ has no existence. I consider these results as interesting as they are unexpected, because we should have considered the existence of that last compound probable as it contains just half the original amount of water, and an even number of molecules. Since the publication of these results, I have examined a large number of substances, and as some of them are natural minerals, I think this the proper place to discuss the results.

The first mineral of which a complete examination was made was opal, a good white specimen of this hydrate of silica of Sp. Gr. 2·125 being used. It was reduced to a very fine powder and a portion ignited to determine the total amount of moisture it contained, and the total loss was found to be 8·85 per cent., agreeing pretty well with the formula $3\,SiO_2,\,H_2O$ which requires 9·09 per cent. A quantity of the substance was weighed out, placed in a drying tube, which was immersed in a water bath, and heated to boiling; a current of air dried by passing through several vessels of strong sulphuric acid was passed over the substance in the tube, and two U tubes containing pumice stone saturated with the same acid, were used to collect the evolved moisture, one being attached to the apparatus while the other was being weighed, by these means keeping the dehydration going constantly. The weighings were done every 5 minutes while the moisture came off with sufficient rapidity to make a difference of about a centigram in the tube, and at longer intervals as the rate became slower. The reason for not allowing more than a centigram to pass into a tube at one time is because when air is so thoroughly dried as it was before passing over the mineral, it has an extreme avidity for moisture, and if the vitriol coating the pumice stone becomes in the least degree weakened, the moisture is not absorbed. In some cases where the mineral or other substance was very difficult to dehydrate two tubes containing anhydrous phosphoric acid had to be placed (one before the air entered the drying tube, and the other before it passed out at the other end of the apparatus), in the circuit, because the slightest quantity of moisture in the air prevented it from dessicating the substance.

The following table gives the rate at which the water came off from the opal.

Time.		Grs per. cent.		
5 minutes	.. ..	1·31	,,	
5 ,,	.. ..	1·28	,,	5·01 per cent.
5 ,,	.. ..	1·20	,,	
5 ,,	.. ..	1·22	,,	
5 ,,	.. ..	0·18	,,	
20 ,,	.. ..	0·72	,,	
20 ,,	.. ..	0·58	,,	
20 ,,	.. ..	0·61	,,	3·23 per cent.
20 ,,	.. ..	0·52	,,	
20 ,,	.. ..	0·60	,,	
20 ,,	.. ..	0·02	,,	
Total 2 hrs. 25 Mins.		8·24 per cent.		

From these figures we see that about one half of the moisture came off at a definite rate of about 0·26 per cent. per second, but the other half at not much more than a tenth of that rate, or at a rate of 0·036 per cent. per second. The second portion seems low, the reason being that the whole of the moisture was not driven off, and if we add the difference between 8·85 and 8·24 to the second portion, we get 3·84 which brings it closer. If we plot these figures as in the curve, fig. 9, plate V, we obtain a broken line, and that break shows the position of a multiple proportion compound having the formula 6 Si O_2 H_2O. That substance is known to exist in certain forms of opal, such as hyalite, but the above numbers give no evidence of those intermediate forms which are described by Klaproth and others. Now to see if these natural forms of Silica agree in constitution with the same substance formed artificially, two different specimens of hydrated silica were prepared, the first by passing silicon tetrafluoride into water, and the other by adding ammonia to hydro-fluo-silicic acid, and boiling. Both were well washed with hot water and pressed between cloths in a screw press, and the cakes so obtained reduced to powder, and allowed to get dry by exposure to moderately dry air. They were not placed under a desicator, because many substances lose most of their water by drying over oil of vitriol. In that manner, I obtained two fine white powders without having used any but natural evaporation for their preparation. Each of those specimens was treated like the natural silica, that is the total moisture estimated in one portion and the rate of dessication at 100 per cent. done in another.

The following tables give the numerical results, while the curves in the diagram show graphically the progress of the decomposition. The total amount of moisture in each case was for No. 1 55·48, and for No. 2 55·92. This agrees very well with the formula Si O_2 4 H_2O, which requires 54·55 per cent. H_2O, the slight excess being owing to hygroscopic moisture. The rates were as follows:—

Rate.	No. 1. Per Cent.		No. 2. Per Cent.	
5	11·33	41.92.	12·17	42·99.
15	30·59		30·82	
20	8·13	8·13.	7·37	7·37.
20	0·80		0·75	
25	0·87		0·80	
20	0·81	4·06.	0·83	3·99.
20	0·80		0·79	
20	0·78		0·82	
Total 2 hrs. 25 m.	54·11		54·35	

It will be seen that the latter part of these figures agree very well with that obtained from the natural silica. The time taken for dehydration was by chance the same in the two artificial as in the natural substances, but the former were not dehydrated so completely as the latter. These figures point to the existence of some interesting compounds, which may be seen from the following table. The original silica may be represented by the formula $SiO_2 + 4\ H_2O$, or multiplied by 6 as $6\ SiO_2 + 24\ H_2O$, when the decomposition will be represented as follows:—

Decomposition.	Substance formed.	Loss. Found.	Loss. Calculated.
$6\ SiO_2\ 24\ H_2O - 18\ H_2O$	$= 6\ (SiH_2O_4)$	42·45	40·90
,, -23 ,,	$= 6\ Si_2O_3H_2O$	50·20	52·27
,, -24 ,,	$= Si_2O_3$	54·23	54·55

We see that only the last of these compounds agrees with the natural mineral, but it shows that artificially prepared silica has nearly the same properties as the natural substance, because the rates of dehydration are practically the same for similar stages of decomposition. The first portion of the mineral gave 0·26 per second, and the corresponding portion of the artificial 0·38; the second 0·036 and 0·040, the greatest difference being between the two first portions. I think, however, that this may be explained by supposing that the compound $3\ SiO_2\ H_2O$ exists in the artificial state as well as in the natural, and that the rate of 0·38 represents the average of the two decompositions $6\ SiO_2$, $6\ H_2O - 4\ H_2O$, and $6\ SiO_2$, $2\ H_2O - H_2O$, which last is the first of the decomposition in the mineral. A more minute examination of the rate at this point would settle that question, and such I intend to make. Certain other minerals are in a forward state of examination, but as some points of the curves require revisal, I shall reserve the publication of the results for another paper. The compounds of silica shown by this method may be tabulated thus.

$6\ SiO_2\ 24\ H_2O.$
$6\ SiO_2\ 6\ H_2O.$
$6\ SiO_2\ 2\ H_2O.$
$6\ SiO_2\ H_2O.$

V.—*On an easily constructed form of Reflecting Goniometer.*

By J. B. Hannay, F.R.S.E.

ABOUT two years ago, while working at the crystalline form of a number of chemical substances of which I could obtain only small quantities, and in consequence minute crystals, I found that a great deal of time and trouble were lost in consequence of having the use of only one goniometer. When a crystal was fixed in its place by canada balsam and carefully centred,—a tedious operation when carried on under the microscope, as I had generally to do,—its angles measured and description noted, I found I often wanted to keep it for comparison, but before another could be examined, the first had to be taken off and half an hour spent before the second could be got into a satisfactory position, the first being very often spoilt in being removed, or even if still entire, much time must be lost before it can again be referred to. Now the possession of half a dozen instruments would obviate all this, but few chemists can afford the luxury of such a number of goniometers, and unfortunately so few possess one at all that it is seldom that such a thing can be borrowed. Finding myself in this predicament, I determined to construct an instrument which might serve the purpose of a more expensive apparatus, but which would be easily and cheaply made, and after several trials I succeeded in finding a form of gomiometer which has admirably served my purpose, and I think that since it has proved so serviceable to myself, I might help some of my brother mineralogists by bringing it before them.

It consists of a tripod stand A figs. 1 and 2, plate IV, made of four pieces of glass rod fused together at A, one for the stalk, and three for the foot, two of which are longer than the third and bent horizontally at B to admit of the instrument being held steadily by a weight or book being laid on the two feet, or it may be fixed by them to a wooden stand. To the top of the stand is fixed a tube C, which is narrowed at one end E till it is rather smaller than the rod D, which is bent into a handle at one end and narrowed slightly at the other so as to pass through the point E, into which it is ground with emery till it turns smoothly; a piece of cork F supporting the other end of the

rod in the centre of the tube. A piece of rod G bent twice at right angles, to one end of which is fused the tube H, is melted on at K, and above this but a little nearer E the pointer L is fixed, while the little bent rod I is carefully centred in the tube H by means of two pieces of bored cork. A large disk either of mica or card board is then fixed with glass cement on the tube at E, and a vernier at the point of L. Should this scale be of mica it must be put on before melting on G or L, but if of card board it may be cut radially to the centre and slipped into its place afterwards, the cut being subsequently carefully gummed together.

Two pieces of cork, one fixed with cement to K, and the other stuck loosely on the point of I, finish the instrument. The reason for having the cork on I loose, is that when minute crystals are to be examined, this cork may be removed and the point of I covered with canada balsam, the crystal being then stuck thereon and centred, and when larger crystals are being examined, the cork is replaced and the crystal wedged between the cork of I and that of K. Of course the corks with which I is fixed in the tube H should be rather tight, so that there may be sufficient friction to hold an ordinary crystal firmly. The reason for having the point of the rod D ground into E, is that not only does it keep the rod in its right place, but that on pushing the rod into the tube a little firmly, the apparatus may be wedged at any angle and left for a long time without any fear of its getting loose. The ground part should be slightly greased. I would remark that the scale of the instrument can, with ordinary care, be divided correctly to half minutes of arc, and this with a vernier gives an instrument which reads to seconds, and anything further is not required in ordinary crystallographic comparisons. Fig. 1 is from a photograph of one of the instruments, which may of course be made much more ornamental, but as it stands, so easily is it constructed that many of my students have made instruments for themselves, and have, consequently, that not very common attainment for a chemist a knowledge of practical crystallography. The disc of the instrument illustrated in fig. 1 has a diameter of nine inches, the other parts being in proportion.

VI.—*Notes on Vauquelinite from Scotland, and Cantonite from Cornwall.*

By Thos. Davies, F.G.S.

WHILST detaching a small crystal of leadhillite for examination with the polariscope, from a specimen brought from the Leadhills, Lanarkshire, which came into my possession some years ago, I observed one side of the mass to be more or less encrusted with a thin drusy coating, which, from its hardness and streak, I was led to suspect might be either the above species, or Laxmannite, described in 1868 by Nordenskiöld in the *Journ. f. prakt. chem.* of that year.

The bulk of the specimen consists of massive greenish pyromorphite mingled with cerussite, upon this occurs the vauquelinite. The remaining minerals are lanarkite, leadhillite, caledonite in tufts of minute acicular crystals, massive black cerussite and quartz. The thinness of the crust rendered it impossible to separate sufficient pure material for analysis without the entire destruction of the specimen, but small fragments were obtained sufficiently clean to establish its identity by means of a blowpipe examination.

Yielded no trace of water when heated in glass tubes; on charcoal easily fused to a dark-grey mass with small globules of lead. The characteristic copper and chromium reactions were obtained in the phosphorous salt and borax beads. Phosphoric acid was not tested for, because of the uncertainty of even the smallest fragment being freed from a minute adherent portion of pyromorphite, but the entire absence of water, a constituent of Laxmannite, point to the species vauquelinite.

A second specimen in my possession is from Wanlockhead, Dumfriesshire, and also occurs as an exceedingly thin crust upon massive pyromorphite, the associated minerals in this case being vanadinite and a little calamine (zinc carbonate). The same distinctive reactions were obtained as in that from Leadhills.

COVELLITE AFTER GALENA *(Cantonite)*.

A few years since, the late Miss E. Carne of Penzance, submitted to me some specimens which, in rearranging her interesting and valuable collection, had given her some trouble in their identification. Among them was a pseudomorph of covellite after galena (cantonite) which, at that time, had been observed but in one locality, the Canton mine, Georgia, where it was associated with copper-glance after galena (harrisite). No record of its occurrence in Cornwall was in existence, to my knowledge, and the specimen with its associations bore such resemblance to those from America that I had great doubts as to the accuracy of the locality assigned to it. Miss Carne, however, did not doubt but that it came, as stated on the label, from the Wheal Falmouth, Cornwall. The label accompanying it, is as follows: "Copper ore with the fracture of galena.

Copper	64
Iron..	3·5
Lead	3·25
Sulphur	25
Sulphuric Acid	1·25
Minute portion of Silver and loss ..	3
Huel Falmouth."	100

Some time after a specimen of the same mineral came into my possession with a label as follows:—

"The accompanying is a specimen of a singular ore lately rose at Huel Falmouth, containing upwards of 60 per cent. copper, and the residue very rich argentiferous lead; it was analysed by an assayer in Gwennap. As I cannot find the substance described in any mineralogical work, I have sent some specimens to Professor Jameson, at Edinburgh, for a more complete analysis, and I expect an early answer, the contents of which I shall be happy to communicate to the Society.—W. Tennant."

I have not been successful in my search for this analysis.

In the Trans. Roy. Geo. Soc. Cornwall, in the volume for 1832-8 I subsequently met with the results of an analysis made by John Michell of a "copper ore from Huel Falmouth," as follows:—

Cu	64·0	S	25·0
Fe	3·10	Sulph. Acid	1·5
Pb	3·5	Ag. & loss	3·0

These two analyses evidently refer to the same mineral, and taking into consideration its pseudomorphic origin, both of these results would correspond very fairly with that given by Pratt in the *Am. Journ. Sc.* Vol. 23, 1857, p. 418.

The physical and blowpipe characters of this specimen require no especial description, as they differ in no respect from those of the well-known American specimens. Associated species, cerussite.

I have to thank Mr. C. C. Ross of Penzance for kindly furnishing me with information of another locality represented in the collection now in his possession, viz.:—Wheal St. George, Perran. I am also much indebted to the same gentleman for the loan of a specimen from the Wheal Falmouth for comparison.

VII.—*Note on certain Black Quartz Crystals from Boscaswell Downs, Cornwall.*

By J. H. Collins, F.G.S., *Honorary Secretary.*

In the autumn of 1871 I found in a large cavity or "vugh" in the schorlaceous granite of Boscaswell Downs, in the parish of St. Just, Cornwall, a number of black and opaque hexagonal prisms, having ragged terminations, which I at first took to be pseudomorphs of black tourmaline *(schorl)*, after quartz. They were set aside for further examination and forgotten until the beginning of the present year, when I undertook their examination.

I found that, although they were very compact, the sp. gr. was only 2·747, which at once negatived the idea of schorl, the sp. gr. of which ranges from 3·0 to 3·3. I then cut a number of sections for microscopic examination, and these at once shewed that the prisms were composed of clear and colourless quartz, containing an immense number of tourmaline crystals, mostly very thin and arranged in feathery groups as in Plate III, figs. 1 to 4. A few of these included crystals are comparatively large, $\frac{1}{100}$th, $\frac{1}{50}$th, or even $\frac{1}{12}$th of an inch thick, and three or four times as long, but the great majority are from $\frac{1}{2000}$th to $\frac{1}{10000}$th of an inch thick. The larger crystals are yellow, brownish, or greenish; translucent, or even transparent; the smaller ones with low powers appear to be black and opaque, but with the $\frac{1}{5}$th are seen to be transparent and nearly colorless. We have, therefore, the somewhat curious result of a colorless transparent quartz appearing black and opaque from the presence of numerous nearly colorless microscopic crystals.

All the included tourmaline crystals exhibit distinct hemimorphism. The larger ones are often branched at one end, as in fig. 3, and some of the smaller ones are branched as in fig. 4, but whether simple or arranged in compound groups, the form of the individual crystals appears to be somewhat as represented in the diagrams, fig. 5.

I have cut sections in various directions but see no difference whatever in the grouping or arrangement of the feathery bunches, which seem also to be entirely independent even of the "lines of growth" of the quartz, which are distinctly indicated by concentric linear groups of minute cavities as shewn in figs. 1 and 2. The only instances in which I have observed any relation between the form of the quartz crystal and the grouping of the minute crystals of tourmaline are illustrated in fig. 2 where many little feathery groups are seen to have their origin at the exterior of the crystal. This is quite different from what is seen in connexion with the inner "lines of growth," and would go to prove that these latter do not indicate former exterior surfaces of the prisms.

In one or two cases I have found, included in the quartz crystals, besides the well-formed crystals of tourmaline, fragments of a white amorphous substance which is not less hard than the quartz itself, and which may be amorphous silica.

On the whole I cannot help thinking that this mutual association of well-characterized quartz and tourmaline indicates that the materials assumed the crystalline form at the same time; and from the inclusion of particles of amorphous substance, I should suppose that the crystallization had been tolerably rapid.

VIII.—*Further notes on the Oxides of Iron, enclosed in Quartz, at Mwyndy, Glamorganshire.*

By Wm. Vivian.

SINCE my communication on this subject published in the first number of the *Mineralogical Magazine*, I have made further observations, and have found other specimens greatly varying, but all embodying the same general principle of solid quartz enclosing the oxides of iron.

The quartz is perfectly solid, breaking with its usual conchoidal fracture, and though richly colored with the oxides of iron disseminated through it in beautiful forms, is itself transparent, so that the forms and colors of the iron are well seen. The colors are various shades of red, yellow, amber, grey, &c., and these colors are distributed in well-defined forms, and not in mere tints as in the case of amethyst, &c.

The forms of the iron are greatly diversified, as indicated in Pl. III. Sometimes as mere lines, nearly straight but hollow, and including little vesicles as in figs. 6 and 8; this form is mostly in massive quartz, but when the quartz occurs in angular crystals then the iron oxides are denser and convoluted or doubled back upon themselves, sometimes producing a finely granular appearance as in fig. 10. A third form, fig. 9, is of an olive color, and composed of thicker lines, branching out, not unlike some kinds of coral; a fourth, fig. 7, has a centre, or core, of grey crystallized iron oxide, and presents a tangled mass of arborescent form, through which it is hard to detect any trunk or root to the mass. The olive color of this form seems to be derived from the grey oxide, seen through, and in combination with its thin translucent yellow coating.

Wherever seen, either in extended linear forms, in arborescent clusters, or in denser masses encircled with quartz, a coating of colored oxide always appears between the grey iron and the quartz.

It should be noted that contact with the quartz seems to have changed the character of the grey oxide. In some places the coating is sufficiently thick to show a crystallized structure; seen in a cross section there is a series of crystals arranged on a radiate system,

similar to that of limonite, and swelling out into the surrounding quartz with botryoidal roundings, but generally it exists as a simple coating over the core on all sides.

This change seems to have been secondary to the linear formation of the grey oxide, and was apparently caused by the partial or entire decomposition of the first ore, for the crystalline form is different, the grey ore being a congeries of scalene or foliated crystals. In some of the lines where hollow tubes are seen, the grey iron seems to have entirely disappeared in forming the yellow coating.

If I may express an opinion on these peculiar primary formations of iron in quartz, I may say that the deposition of the different substances took place at the same time, and that they assumed their forms under the action of the crystallizing forces acting on the iron oxide and quartz simultaneously, that is, while the oxide was suspended in the quartz and pushing out into dendritic lines, it was controlled and modified by the quartz assuming its own angular structure.

The diagrams given illustrate the forms referred to in the paper, though they fail to convey a perfect idea of the extreme delicacy, beauty, and variety of form and colour seen in this microscopic structure.

IX.—*Notes on the Occurrence of Chlorite among the Lower Silurian Volcanic Rocks of the English Lake District.*

By J. Clifton Ward, Assoc. R.S.M., F.G.S., of Her Majesty's Geological Survey.

THE Volcanic Rocks of Lower Silurian age in the Lake District are interesting in the highest degree on many accounts, and not least so on that of the extreme metamorphism which they have undergone, partly by the deep burial they suffered during the period between the close of the Lower Silurian and the Old Red, when they were once more largely uncovered,* and partly by that never-ceasing action of infiltration, decomposition, solution and replacement to which all rocks are subject during the course of geological time, but to which rocks of an originally volcanic origin seem specially subject.

If there is one feature in this metamorphism of the Cumberland rocks more prominent than another, it is the large degree to which chlorite has been developed among them, and the universality of its occurrence.

Chlorite and its more unstable allies, delessite or chlorophœite, occur in the first place in a diffused or finely divided state in the base of all the old Cumberland lavas, filling up the interstices between the numerous felspar needles so characteristic of these old flows. This abundance of diffused chlorite gives a general diabasic character to the lavas. Under the head of Diabase, Zirkel remarks (Mikroskopische Beschaffenheit, p. 407) that the diffused greenish mineral seems to be chlorite and probably a decomposition product of augite, and the same is very likely the case among the Cumberland rocks, for the larger augitic crystals which occur in considerable abundance among some of the lava-flows are often replaced by chlorite in precisely the same manner as the diffused chlorite seems

* See "Geology of the Northern Part of the English Lake District," Chap. XII.

to have replaced some previous minutely diffused mineral. The brownish colour sometimes assumed by the chloritic mineral seems to be due to change of the more unstable varieties by exposure. Many of the small intrusive masses of both dolerite and diorite are likewise fully charged with chloritic minerals, chlorite sometimes also lining the fine joints and cracks. The vesicles which occur in great abundance in some of the lavas are often filled with chlorite, or chlorite lines the cavity, which is filled with calcite, chalcedony, or quartz.

The most remarkable mode of occurrence of this mineral is, however, among the beds of volcanic ash in their various stages of metamorphism. In an ash comparatively but little altered, while many of the broken crystals will be represented by chloritic pseudomorphs, chlorite may occur but sparingly developed in the finer dust or granular matrix. But in most cases it occurs in such quantity as to impart a general green colour to the ash rocks, which is seen especially well in the cleaved ashes or "green slates" as they are called.

A curious feature among the altered coarse ash beds is that of a flow of chloritic granules around the larger fragments; this has been illustrated in the Survey Memoir before mentioned (Pl. II, fig. 14), and in my paper on Ancient and Modern Volcanic Rocks (Quart. Journ. Geol. Soc., vol. xxxi, pl. xviii, fig. 13). Such altered ash rocks are often exceedingly compact and trap-like, but the outlines of the original fragments are not seldom plainly discernible on the weathered exterior. When viewed in a thin slice under the microscope the fine matrix appears decidedly granular under a high power, but the granules are frequently collected along lines which sweep round the larger fragments in oftentimes graceful curves, and are mainly composed of green chloritic matter. The universal presence of this structure, with an extreme of alteration, such that the outlines of the original fragments are only barely discernible, convinces me that the granular chloritic flow has been produced subsequently to the formation of the rock by excessive metamorphism.

There are other cases in which the ash being very fine and uniform in grain, an equal amount of metamorphism has taken place without much of the flowing or streaky character being developed. A well-bedded ash in Great Gable is an example; the bedding in the mass is clearly seen, but in hand specimens the very

faint lines are with difficulty traceable, garnets are developed in tolerable abundance, the look and texture of the rock is trap-like in the extreme, and throughout the felsitic looking base there appear under the microscope an infinite number of very minute particles of chlorite and brown mica. In some instances there occur fine clouds of these minute chlorite particles only, and in others the particles seem partly chlorite and partly mica. As however, the alteration becomes still more excessive on nearing the large tract of Eskdale granite, the rocks assume a marked purplish hue, and in all such cases the chloritic particles seem to have given way to similar particles of green and brown mica. A stage nearer the granite the altered rocks become distinctly porphyritic, and the mica particles more and more defined and flaky, and are sometimes collected thickly round the edges of imperfectly formed felspar crystals, as if pushed outwards in the growth of the latter.

Have we not here then a gradual passage from chlorite into mica, a hydrous into an anhydrous mica, on approaching the granite tract? The first step in the metamorphism seems to be the formation of chlorite throughout the rock, often assuming a streaky arrangement around the larger fragments; the second, the conversion of the chlorite into magnesia-mica, or even into potash-mica; and the third, the collection of the mica into groups and larger flakes. Of course, I shall not be understood to mean that this mineral evolution takes place by itself unconnected with the associated minerals; it is the change which is worked in the whole rock, in all the mineral constituents, that enables this conversion of one mineral species or variety into another to take place. Thus the decomposition of one silicated mineral would furnish silica for the further silication of another mineral species or variety, or for the production of another mineral altogether, the formation of garnets in the altered rocks by union of the excess of silica with alumina, being an example of the latter process.

It now remains to mention examples of the occurrence of chlorite on a larger scale among some of the altered rocks surrounding the Eskdale granite. In Eskdale, especially about Harter Fell and neighbourhood, both chlorite and epidote are very abundant in nests and strings. In many places the rock is quite seamed with veins of chlorite, which under the microscope is seen to occur often in fine fan-shaped crystalline groups, showing bright colours under crossed prisms and a well-marked dichroism when the polarizer is alone used and rotated.

Occasionally, the highly altered ash-rocks near Harter Fell, besides being seamed with chloritic veins, are full of small nests of chlorite and quartz, ranging from about $\frac{1}{4}$in. to 1 inch in diameter. These nests are generally lined with chlorite and filled with quartz, but not unfrequently the two minerals are more or less mixed, and sometimes the whole is composed of fibrous crystalline chlorite. The weathering of the rock brings out these nests in more or less relief upon the surface, which then appears as if studded over with many round black nodules, and these may sometimes be taken out whole from the rock by a little careful hammering.

X.—*Note on a peculiar form of Quartz Crystals from Australia.*

By the Rev. J. M. Mello, F.G.S.

THIS quartz, the precise locality of which is unknown, is different to any that I remember having previously seen. It is apparently from a mineral vein, and consists of an assemblage of quartz pyramids, which differ from the usual form in having each angle apparently supplemented by a small prism, giving to the centre block a curious stellate appearance, fig. 8, Pl. V.

The interspaces are filled up with minute pyramidal crystals of quartz, as well as others of chalybite and pyrites.

The fractured under surface fig. 7 shows an infinity of concentric lines of growth, the interior being composed of transparent quartz, while the outer layers are milky and opaque.

A closer examination of these crystals shews that those edges of the "supplementary prisms" which bound the interspaces are rough, in other words it appears as if these interspaces were due to deficiency of material and not to a peculiar made formation as the words "supplementary prisms" would imply. That the interspaces are not caused by corrosion is clearly shewn by the cross-section in fig. 7 in which the concentric "lines of growth" are seen to follow the present irregularity of the exterior surface.

XI.—*Notes on some North American Pyrrhotites, and other Minerals containing Nickel.*

By Henry How, D.C.L., Professor of Chemistry, University of King's College, Windsor, Nova Scotia, *Corresponding Member.*

IT is a well-known fact that Pyrrhotite, or Magnetic Iron Pryrites, frequently, if not invariably, contains nickel, generally with cobalt in various proportions, amounting together from traces, up to nearly six per cent., and that most of the nickel of commerce is derived from this mineral

The following notes contain in the first place the results of the examination of a few varieties of pyrrhotite, occurring in Nova Scotia, New Brunswick, and the United States, chiefly with reference to presence or amount of nickel and cobalt, and they shew also that remarkable differences exist in the intensity of the magnetism displayed, which ranges from distinct polarity in the mass, down to very feeble attraction by a magnet in the finely powdered state of the mineral, and further, that the most feebly magnetic of the specimens examined is that containing the largest per centage of nickel. The subsequent notes relate to other species from Nova Scotia and Newfoundland.

Pyrrhotite from Cape Breton Island, N.S. Of this mineral, four pieces were examined, they were all polar in action on the magnetic needle, one piece being very strongly so; the mineral was in the massive state, with, however, somewhat lamellar structure, associated with quartz. Portions of each of the four pieces were taken together for analysis, the object being to get an average of the whole, which, for the following metals, amounted to

Oxides of nickel and cobalt .... 0.50 per cent.

in these, on separation by potassium nitrate, there proved to be at least

Metallic nickel ..... 0.36 per cent.

and there was a trifling loss in the operation. The locality of this specimen, I should say, I find is not certainly known to the person from whom I obtained it.

Pyrrhotite from Nictans, Annapolis Co., N.S. The mineral occurs here also massive, with quartz: it attracts both ends of the magnetic needle. Analysis gave:—

Nickel with a little cobalt .... 0.10 per cent.

Pyrrhotite from Geyser's Hill, Halifax Co., N.S. In this case no note is on record as regards magnetic intensity, but the mineral gave a distinct reaction for nickel.

Pyrrhotite from Latite, New Brunswick Several specimens from this locality, where, I understand, on good authority, the mineral occurs in considerable quantity, examined at different times, have given results shewing that the quantity of nickel and cobalt is far from uniform. The mineral is massive, finely granular, and attracts both ends of the needle readily. No attempt was made to separate the nickel and cobalt found, the metals were thrown down as oxides, and calculated as from protoxide of nickel,

No. 1	afforded, per cent.	0.09	"nickel."
No. 2	,, ,,	0.36	,,
No. 3	,, ,,	0.80	,,
No. 4	,, ,,	0.40	,,

the "nickel" was proved to contain a considerable proportion of cobalt in the last three cases, no note was preserved as regards the first; in the last, No. 4, manganese was detected before the blow-pipe by the soda test. This sample was averaged on the spot by an experienced person interested in obtaining a correct representation of the deposit, and the "nickel" obtained above is just the average of that got in the three preceding experiments; a circumstance I did not observe till these notes were put together.

Pyrrhotite from Lowell, Massachusetts, U.S. Specimens of this were placed in my hands, last autumn, as of a mineral containing 25 to 30 per cent. of nickel. It is found over a considerable area, and is, I believe, being worked. The mineral is coarsely granular, no crystals were seen on the specimens given to me; it occurs with a highly siliceous rock containing a little mica, specimens running in veins sometimes half an inch thick through the ore in hand-specimens. The magnetism is so feeble that it is only perceived by actual contact of the finely powdered mineral with a magnet, when an

exceedingly small quantity is retained. This property and the similarity in some characters, and in qualitative composition to Pentlandite, together with the statement as to the amount of nickel present, made a quantitative analysis desirable. The results of one on a piece of pure looking mineral were these:—

Sulphur	33.91
Iron	53.75
Nickel	2.41
Gangue	8.30
Magnesia and Loss..	1.63
	100.00

which shew conclusively the individuality of the mineral, the composition of Pyrrhotite and Pentlandite being as follows:—

	Pyrrhotite.	Pentlandite.
Sulphur	40	36.0
Iron	60	41.9
Nickel	(up to 6 ?)	22.1
	100	100.0

The nickel obtained in this and in a qualitative analysis gave no indication of cobalt with borax before the blowpipe. On comparison of the per centage of nickel with that in the mineral from Cape Breton Island above, and of the respective magnetic powers, it appears that the polar mineral contains only 0.36 per cent. of "nickel," while this metal in the scarcely magnetic species from Lowell approaches ten times that amount.

Mispickel from Montagu, Halifax Co., N.S. This mineral, frequently associated with gold, which it sometimes holds in visible quantity, in various parts of this province, has before been shewn to contain cobalt at the locality indicated (*Mineralogy of Nova Scotia*, p. 62), by experiments made at Freiberg. The specimen now referred to gave me, approximately,

Metallic Cobalt.. .. .. 0.09 per cent.

containing manganese, as shewn by the soda test before the blowpipe.

Mispickel from Lunenburg Co., N.S. This was from a gold district some 50 miles S.W. of the preceding. Qualitative tests shewed small quantities of both nickel and cobalt. I may mention that mispickel occurs here in exceedingly well-defined crystals of brilliant lustre.

Matrix of Pickeringite, Newport, N.S. When in 1863 I published (*Journal of the Chemical Society*) the analysis of Pickeringite, which resulted in the establishment of a new group of salts and minerals (*Pseudo-alums, Odling, Outlines of Chemistry*, p. 282, and "*Halotrichite Group*" *Dana, Mineralogy, 5th Ed.*, p. 651), I shewed that the N.S. mineral contained some two thousandths of nickel and cobalt, and that I failed to find these metals in the rock from which the mineral had been formed. The method of attack on the rock used at that time was fusion with carbonated alkali. I have since found that by treating about 50 grains of the slate, taken (by myself) from the interior about two feet from the outer edge, with aqua regia, distinct evidence of the presence of both metals was obtained from the rock, which looked quite free of any sulphides or other minerals of metallic lustre.

Millerite from Tilt Cove, Newfoundland. A specimen of "nickel ore" given to me last year proved to be Millerite; it was of pure yellow colour, in six-sided crystals and plates, associated with pearl-spar and quartz, and a green mineral in small quantity, probably zaratite. It appeared to be very pure, giving the blowpipe reactions of sulphur and nickel only. It is found at the same place in "leaves like the purest gold," and also in radiated crusts, such as occur at Gap Mine, Pennsylvania, according to a gentleman who said specimens he had seen from Tilt Cove, were like what I shewed him from the U.S. locality named. From the same authority, I learned that this species forms but a small part of the nickel ore at Tilt Cove, which is chiefly Kupfernickel occurring in pockets with the copper pyrites so largely mined for the last few years. Specimens of this Kupfernickel, in my possession, consist almost entirely of the massive mineral with dolomite. About 113 tons of the ore were shipped in 1869 and the following year; later statements I have not at hand.

Reviews and Notices.

*Professor Groth's New Magazine.**

WHATEVER expectations may have been formed of the new Crystallographic Journal announced some months ago by Prof. Groth, they have assuredly been realized to the full by the issue of the first number. Before presenting to our readers a digest of its contents, it may be well to note a few general rules that have been laid down at the outset for the guidance alike of contributors and readers. These rules are necessitated by the present want of uniformity in crystallographic notation. Both Miller's and Naumann's symbols are employed, the two being, in most cases, written side by side; but no other system is to be admitted. In referring to the crystallographic axes they are always taken in the order which Weiss originally introduced; that is to say, *a* denotes the axis which runs to and from the observer, commonly taken as the brachydiagonal in the rhombic and the asymmetric system, and the clinodiagonal in the monosymmetric or clinorhombic system; *b* is the axis running right and left, which is generally taken as unity; and *c* is the vertical axis. In dealing with the hexagonal system, for which so many different suggestions have been made, the Editor recommends the adoption of Bravais' proposal to use *four* indices, of which *h*, *k*, *l* refer to the three lateral axes, and *i* to the principal axis. In citing angular measurements, the normals of the angles will be given.

Professor Vom Rath opens the Number with the first of a new series of *Mineralogische Mittheilungen*, being indeed a continuation of the reports which we have been in the habit of looking for in Poggendorff's *Annalen*. The present series of communications commences with an article on the crystallization of *gold*, referring especially to

* Zeitschrift für Krystallographie und Mineralogie, unter Mitwirkung zahlreicher Fachgenossen des In-und Auslandes herausgegeben von P. Groth. Leipzig: W. Engelmann, 1877.

an interesting specimen from Vöröschpatak in Transylvania, already described by Hessenberg. This is a beautifully crystallized plate of gold; the tabular crystals, well seen on the edge of the specimen, being produced by twinning. The twins consist of a combination of cube and octahedron, sometimes with the icositetrahedron 303. The twin-plane is parallel to a face of the octahedron, and the upper and lower sides are also octahedral faces. These normal twins suffer peculiar distortion, as seen in some of the individual elements from the centre of the specimen. The crystals are greatly extended in a direction perpendicular to an edge between the cube and octahedron, or parallel to the diagonal of a face of the octahedron. The rhombic dodecahedron also enters into the composition of these elongated twins. From the primary rod thus formed, two systems of secondary rods shoot out laterally at angles of 60°, and these in turn give off others. Some curiously distorted twins, like little golden knobs, are seated on some of the primary rods. By union of these crystalline elements the forms of the Vöröschpatak gold are produced.

A star-like formation of gold, from Faczebagy, is also described and figured. Each ray is a twin of the pyramidal cube $\infty 02$, round a trigonal axis, and elongated in direction of the diagonal of an octahedral face. In explanation of the acicular and capillary forms of gold, some other specimens from Transylvania are described. The elements of this type, which appear to defy the symmetry of the regular system, are generally prisms of rhombic transverse section, and consist of elongated cubes terminated by faces of the pyramidal cube $\infty 02$; the prisms being striated by oscillatory combination of $\infty 0\infty . \infty 02$. The twin-plane is, as usual, a face of the octahedron. Among other notable crystals of gold some five-membered forms are described. These are 5-sided needles, sharply terminated with faces of $\infty 02$, and either with or without lateral rays.

A curious dendritic specimen of *Speiskobalt* (Smaltite) from the Daniel Mine, near Schneeberg in Saxony, was described by Naumann in 1834. The crystals are twinned according to the law: "Twin-axis a normal to a face of $30\frac{3}{2}$." This specimen has recently been studied by Vom Rath, who finds that, although by far the greater number of the elementary crystals agree with Naumann's description, there are a few little crystals which are twinned according to the law: "Axis of rotation, a trigonal axis." The crystals are a combination of $\infty 0 \infty . 0. \infty 0. 202$; and are regularly formed, whilst

Naumann's twins are always distorted, and have curved faces. The author proposes an explanation of this distortion and curvature.

Some curious crystals of *Rutile*, scarcely to be called pseudomorphs though having their arrangement evidently determined by the crystalline characters of iron-glance, are also described by Vom Rath. The crystallonomic relations between rutile and iron-glance were first pointed out by Breithaupt. The crystalline combination exhibited by the iron-glance, as indicated by the way in which the crystals of rutile are grouped, is that of the base OR, with the dihexahedron, $\frac{4}{3}$P2. The rutile shews the fundamental pyramid P, the obtuse octahedron P∞, the two prisms ∞P and ∞P∞, with several eight-sided pyramids, especially ∞P2. These crystals were found in the Binnenthal in Switzerland; and descriptions are added of other crystals of rutile, curiously disposed in groups of 8. from Hot Spring, near Magnet Cove, Arkansas.

Prof. Vom Rath's paper is followed by one written jointly by Herr Brögger, of Christiania, and Vom Rath. It describes some large crystals of *Enstatite* found in 1874 by Messrs. Brögger and Reusch in the apatite-mine of Kjörrestad, near Bamle in Norway. Some of the crystals exhibit rhombic symmetry, thus corroborating Des Cloiseaux's determinations based on optical characters, but it is curious that most of them are distorted so as to assume a monoclinic habit. The paper has been presented to the English reader in the *Philosophical Magazine*.

Dr. Schrauf follows with a paper on "The Crystallographic Constants of Lanarkite," in which he shews that this species is monoclinic with the angle $\eta = 91°49'$. The ratio of the axes is

$$a : b : c = 0{\cdot}868113 : 1 : 1{\cdot}383634.$$

Nine forms have been determined, including some with very high indices. The vertical axis does not coincide with the direction of greatest growth, so that the needle-like crystals are not to be read vertically. The faces which appear to be prismatic belong to a zone of domes, and the free end of the crystal corresponds with the pole of +Y or—Y, not to one of the poles of the Z-axis.

The fourth paper is by Mr. E. S. Dana "On a regular growth of quartz and calcite." The specimens here described were found by the writer in 1875 near "Specimen Mountain" in the Yellowstone Park. Rhombohedrons of calcite (—$\frac{1}{2}$R) are seated on chalcedony,

and the whole encrusted with quartz. Where the quartz covers the chalcedony it is developed irregularly, but where grown on the calcite the crystals assume a determinate position; the pyramidal faces of the quartz, +R or—R, being parallel to the faces of the underlying rhombohedron of calcite. Although the position of the quartz has thus been determined by the calcite, the resulting forms possess a high degree of symmetry, approximating very closely to that which would be produced by twining parallel to 2P2. The English reader will find Mr. Dana's description in the December number of the *American Journal of Science.*

Passing over the two following papers, which relate to the crystalline forms of certain chemical products, we find an article by Dr. Knop, of Carlsruhe, "On the Schorlomite of the Kaiserstuhl." The author describes the method which he employs for the determination of titanic acid. He concludes that the earlier analyses of titaniferous silicates in general are not trustworthy, on account of the inaccuracy of the analytical methods. The minerals of the Kaiserstuhl that were formerly taken for Schorlamite are either melanite or pyroxene, both of which contain titanic acid. Schorlomite does not occur there. As the true Schorlomite from America occurs with melanite, and the two minerals are said to assume the same crystalline forms, it is possible that there may have been some mistake about the separation of the species, and that Schorlomite may be amorphous.

In addition to the eight original papers noticed above, the Number contains thirty-two extracts from other Journals, &c., bearing upon Mineralogy and Crystallography. English science comes in for a due share of recognition: the papers in the first two numbers of the *Mineralogical Magazine* are duly noticed, and the proceedings of the Crystallological Society, which has as yet no Journal of its own, are reported.

The co-operation of eminent mineralogists in almost every part of the world will strengthen Prof. Groth's hands, and help to render his Journal one of no mean value to all who are interested in the progress of Mineralogy from its crystallographic side.

F. W. R.

Neues Jahrbuch für Mineralogie, Geologie, and Palæontologie. Founded by K. C. von Leonhard and H. G. Bronn; continued by G. Leonhard and H. B. Geinitz. For the year 1876, parts 1—8, 8vo. Koch, Stuttgart.

NOWHERE is Mineralogy more heartily studied in all its bearings, from chemical rock-study to crystallography, than among our scientific brethren of Germany; and nowhere are the results of their assiduous and enthusiastic work more fully and continuously promulgated than in the long-established *Neues Jahrbuch für Mineralogie, &c.*, of which nine numbers are issued every year. Not only is a large proportion of space in this valuable periodical given to original memoirs on their favourite sciences of Crystallography, Mineralogy, and Petrology, but the Editors receive and publish numerous notes and letters on these subjects; and the current bibliographical lists of the contents of scientific works, from all parts of the world, are unusually rich with allusions to memoirs on these and cognate subjects; and, what is more, a dozen or twenty abstract notices of such books and papers, besides those on Geology and Palæontology, are given in every sequent part of the *N. Jahrbuch*, so that the reader can keep with the stream of progress.

The following are the memoirs more especially relating to Mineralogy in the parts for 1876, now before us.

On the Etch-figures (crystal-forms after corrosive etching) of Lithium-mica, Tourmaline, Topaz, Smithsonite, Adularia, Albite, Fluor, and Rocksalt, with two plates, by H. Baumhauer, in continuation of his examination of Potash-mica and Magnesia-mica.

On the spontaneous and independent activity of crystals, both in disturbed conditions of growth and in the native broken and restored state; by Dr. F. Scharff.

On the occurrence of Lightning-tubes (Fulgurites) in the sand-flats near Starczynow, not far from Olkusz in Poland, with a woodcut; by Ferd. Roemer.

On some Eruptive rocks of the Saxon Erzgebirge, namely:—1 The Syenite of Scharfenstein; 2—The compact Syenite; 3—The

compact Mica-diorite, or Kersantite; 3—The Diabase-porphyry of the Tanneberg Valley, in the Voigtland; 5—The Mica-porphyrite of Flöha; by Dr. E. Kalkowsky, of Leipsic.

On a newly discovered vein of Silver-ore in the Troitzk circuit of the Orenburg Government; by W. von Beck.

On the petrography of the Olivine-rocks, Serpentines, and Eclogites of the Saxon Granulite district, with a plate; by Dr. E. Dathe.

Mineralogico-crystallographic Notices (continued from the vol. for 1875), with a plate,; by Prof. A. von Lasaulx, 7—Melanophlogite, a new mineral; 8—A new pseudomorph of Calcite after Bitterspar; 9—The Quartz with grooved edges, from Oberstein and Lizzo; 10—Crystals of Red-copper with grooved edges, from Redruth; 11—Aërinite, a new mineral; 12—Pilinite, a new mineral; 13—Supplemental notice of Ardennite.

Studies on Mineral Pseudomorphs and Pseudomorphosis (with a plate and two woodcuts); by F. Eugene Geinitz: 1—Chalcedony on Fluor, France; 2—Chalcedony after Calcite, Schneeberg, Saxony; 3—Hornstone after Calcite, Schneeberg; 4 and 5—Quartz after Fluor, Cornwall, and Rothenberg near Schwarzenberg, Saxony; 6—Semiopal and Quartz after Calcite, Leisnig, Saxony; 7—Chalcedony after Fluor, Trestyan in Siebenbürge; 8—Quartz after Calcite, locality unknown; 9—Gypsum after Rocksalt, Upper Austria; Chalcedony after Datolite, Haytor, Devon; 11—Greenearth and Calcite after Augite, Fassathal, Tyrol; 12, 13, 14, 15—Limonite after Pyrites, Göttingen, Schindelberg, near Osnabrück, &c.; 16 and 17—Malachite and Azurite after Red-copper ore, Chessy, near Lyons; 18 and 19—Aragonite after Gypsum, Mansfeld, Thüringia, &c.; 20—Calcite after Gaylussite, Sangerhausen, Thüringia; 21—Tinstone after Orthoclase, St. Agnes; 22—Parasite? after Boracite; 23—Sanidine after Leucite, Upper Wiesenthal, in the Erzgebirge; 24—Steatite after Quartz, Göpfersgrün, near Wunsiedel; 25—Steatite after Bitterspar, Göpfersgrün; 26—Rocksalt after Carnallite or Sylvine (according to von Zepharovich), Westeregeln, near Stassfurt; 27 Nacrite after Prosopite and ? Topaz, Schalaggenwald, Bohemia; 28—Lithomarge? after Fluor; 29—Nacrite and Fluor after Prosopite, Altenberg in the Erzgebirge; 30—Martite, Pseudomorph? of Iron-oxide after Magnetite, Nova Scotia, &c.

Description of a new Microscope for mineralogical and petrological research, with a plate and woodcuts; by H. Rosenbusch.

On Turnerite, with a plate; by Dr. Ch. O. Trechmann.

On the Nenntmansdorf Meteor-iron, in the Dresden Museum; by Dr. F. E. Geinitz.

On the occurrence of Serpentine and Olivine-rock in North Norway, with plate; by Karl Pettersen.

On the Twin-growth of the Triclinic Felspars, according to the so-called Pericline-law, and the distinctions founded thereupon, with a plate and two cuts; by Prof. G. vom Rath, Bonn, to whom this study brings full evidence, that the mathematical laws rule with the greatest force in the formation and arrangements of the crystals.

On the temperature in the bore-hole at Sperenberg, and the conclusions derived therefrom, by F. Henrich, who states that the temperature was found to increase steadily with the depth, at the rate of about 0.76 R for every 100 feet.

Chemical researches on the contact-zones and passage rocks of the Steige clayslate and the granitic mass of Barr-Andlau, by H. Unger. The results given are: 1—Both the unaltered and the metamorphosed schists consist of identically the same chemical material; and therefore the change is not produced by either the addition or the removal of any metamorphosing material, but is due to some other still unexplained molecular cause. 2—The andalusite-schists consist of

Titanite	0·7	per cent.
Magnetite	7·2	,,
Magnesia-mica	32·4	,,
Andalusite	24·7	,,
Quartz	36·3	,,

3—The granitite, which has broken through the clay-slate, is of a normal character. 4—The potash-felspar in the granitite is a soda-bearing orthoclase. 5—Near-by a lime-soda-felspar occurs. 6—The contact-conditions of the Steige schists are, for the most part, similar to those described by Naumann in the Voigtland, and closely allied to those observed by Fikenscher near Lunzenau, and by Fuchs in the Pyrennees. 7—Lastly, experiments for producing, by re-agents, an artificial alteration of the material of the clayslate, show that it can, by these means, be partly brought to a crystalline condition.

Our reader will also be able to judge of the mineralogical riches of the *Neues Jahrbuch*, when they see that the correspondence includes such names as Kengott, Gümbel, Dana, Frenzel, Weisbach, Pattersen, A. von Lasaulx, Streng, Zirkel, Sandberger, G. vom Rath, Eck, Baumhauer, Strüver, Kloos, and many others. Some of these letters are of considerable length, and have woodcut sketches, and in one instance (vom Rath) a lithographic plate.

To old workers, of course, the *Neues Jahrbuch* is well known; and younger students will find it quite as indispensible as a storehouse of facts and philosophy, and as a welcome channel of current thought and discovery.

T. R. J.

Tridymite. — *From Prof. C. Doelter's notice to the Imperial Geological Institute of Vienna, November* 21, 1876.—This mineral occurs in the Andesite of Gerecses (Transsylvania). The Andesite is compact, hard, and conspicuously schistose; its colour is black, turning grey by the commencement of structural change; aggregations of Felspar are very rare in it. The Tridymite fills very flat cavities, more than $1\frac{1}{2}$ centimeter in diameter, and of rather rounded outline, between the layers of Andesite. Each hand-specimen shows between 10 and 15 such accumulations, in the form of round, brown or yellow spots. The Crystals of Tridymite are $\frac{1}{3}$, at most $1\frac{1}{2}$, millimeter in length, generally opaque, reddish brown or yellow (very few honey-yellow), pellucid, and with smooth, measurable planes. Most of them are binary, ternary, or still more complicated, fan-shaped combinations.

Thin slices of the Andesite, not highly magnified, show only a confused accumulation of materials, a vitreous substance prevailing. With higher powers, among the few minerals interspersed in it, the following have been ascertained:—Plagioclase, as hexagonal and lengthened rectangular sections of poly-synthetic crystals; Orthoclase, as the Plagioclase, and nearly of equal frequency; Amphibole or Pyroxene, in lamellæ, scarce; Magnetite, in isolated larger granules. Under a magnifying power of 500—600, the amorphous substance is resolved into short, rectangular, simple crystals of Orthoclase, and probably also Plagioclase, interspersed with longish thin microlites (not determinable), and roundish,

occasionally yellowish microlites (Pyroxene or Amphibole?), also Magnetite, in minute granules or square sections, and a vitreous substance.

The chemical composition of the Gerecses Andesite is:—

Silica	64·61
Alumina	15·47
Proto-peroxide of Iron	11·32
Lime	4 73
Soda	1·82
Potash	1·12

T. R. J.

HALLOYSITE OF STEINBRUCK, STYRIA, BY J. GAMPER.—*Imper. Geolog. Institute of Vienna, December 5th*, 1876.—This mineral appears in opaque or somewhat bright fragments, frequently with thin brown veinules of Allophane, in a kaolin-like substance, filling a vein. It is honey-yellow, transluscent at the edges, with white streak, and, on the whole, bearing an external resemblance to Schroetterite. It contains traces of organic substances, as it blackens before the blow-pipe, and deposits a coal-like substance when treated with boiling sulphuric acid. The chemical analysis for these minerals is.

	HALLOYSITE.	ALLOPHANE.
Silica	40·7	24·2
Alumina	38·4	29·1
Lime	0.6	3·1
Magnesia	1·5	traces
Oxide of Iron	traces	traces
Loss by incandescence	18·0	42·9

Both these minerals heated with hydrochloric acid deposit pulverulent* silica.

T. R. J.

THE ACTION OF ORGANIC ACIDS ON MINERALS.—(H. C. BOLTON, *New York Engineering and Mining Journal.*)—Contrary to preconceived ideas, based on general notions of the weakness of organic acids, many minerals in fine powder are decomposed by boiling with solutions of citric, tartaric, oxalic, and other organic acids. Not only do all the carbonates examined (fourteen in number) dissolve with effervescence in solutions of the above-named acids,

* Qy. *gelatinous?* J. H. C.

but many sulphides, silicates, and other classes of minerals are more or less completely decomposed. In many cases the accompanying phenomena, such as evolution of gases, formation of crystalline, precipitates, etc., are characteristic in certain minerals; for example all the specimens of bornite examined yield sulphuretted hydrogen with tartaric acid (also citric and oxalic), while chalcopyrite does not; again, pyrrhotite yields sulphuretted hydrogen under similar circumstances, and pyrite gives no such reaction. Moreover, since citric and tartaric acids decompose potassium nitrate, setting nitric acid free (?), we have a powerful means of attacking sulphides and arsenides which resist the organic acids alone. All the sulphides examined (seventeen in number), with two exceptions, molybdenite and cinnabar, are quickly decomposed by heating with citric or tartaric acid, to which a small quantity of potassium nitrate has been added. Even metallic copper, lead, tin, and silver dissolve in the above mixture of reagents. Potassium chlorate answers very well in place of the nitrate, but the action is slower. Oxalic acid fails to decompose the nitrate or the chlorate of potassium. The action of these acids on the silicates now engages my attention; several of them (natrolite, datolite, wollastonite, calamine, etc.) yield readily to the action of citric acid in solution, gelatinizing as with mineral acids.

Aside from the interest which attends those reactions, there is a manifest advantage in being able to add tartaric (or citric) acid to pocket travelling blowpipe cases; the dry acids are readily transported, and can be dissolved when needed for use. It was during a mineralogical tour last summer that the thought suggested itself of trying the behaviour of minerals with tartaric acid, as a substitute for the mineral acids whose carriage is impracticable.

For microscopic work also the use of these non-volatile acids may be recommended, thus avoiding possible injury to the metallic mountings.

Besides the three organic acids named, I have examined the action of carbonates, at least of malic, formic, and acetic acids, for the sake of comparison; acetic acid gives the least satisfactory results.

So far as I can ascertain, this field has not hitherto been explored. I have ransacked chemical literature for similar studies in vain, and Professor Edward J. Chapman, of Toronto, who is high authority in determinative mineralogy, writes me that while organic acids have

long been used in chemical analysis, their direct application to the examination of minerals is, to the best of his knowledge, entirely novel.

J. H. C.

CONTRIBUTIONS TO THE KNOWLEDGE OF THE PRIMITIVE ROCKS OF THE NORTH-EASTERN PART OF THE BLACK FOREST; BY CARL HEBENSTREIT, WÜRZBURG, 1877 (*Beiträge zur Kenntniss der Urgesteine des nordöstlichen Schwarzwaldes.*)—This essay contains some useful analyses of rocks and their component minerals. The author has taken great pains to ascertain the exact composition of certain varieties of gneiss, actinolite rock, and granite.

The gneiss from Schapbach is remarkable for containing an orthoclastic felspar with only 2·92 per cent. of potash, whilst there are 9·22 per cent. of soda, and 0·81 of baryta.

C. L. N. F.

ZIRCON.—ON THE COLOUR OF THE ZIRCON; BY G. SPEZIA, *Atti della Reale Accademia della Scienze di Torino, Vol. xii*, 1876.—The property possessed by the Zircon of losing its colour on being heated, has been attributed by Rivot to the presence of organic matter, which is destroyed at a high temperature. Chandler, on the other hand, supposes that changes of colour are caused by the different degrees of heat to which the mineral has been exposed. Signor Spezia, however, after numerous experiments, has arrived at a different explanation, and he considers that the alteration is due to a difference in the state of oxidation of a colouring metallic oxide.

Amongst other experiments he exposed a zircon to the reducing flame before the blowpipe, and it lost its colour; it regained it when subjected to the oxidizing flame, or when heated in a current of oxygen gas. Chemical analyses show that the zircon contains a a little ferric oxide, and the reduction of this to the state of ferrous oxide probably causes the loss of colour; if rich in iron, the zircons do not become quite colourless, but assume a greenish tint.

C. L. N. F.

LUDLAMITE (F. FIELD; *Phil. Mag., Jan. and Feb.* 1877.)—This is a new hydrated basic ferrous phosphate, which has been found in Cornwall associated with quartz, chalybite, pyrites, mispickel, Vivianite, galena, blende, and fluor. Its H is 3—4; G 3·12; colour

clear green, from pale to dark; transparent; brilliant vitreous lustre. BB on charcoal it tinges the flame slightly green, and yields a semi-fused blackish magnetic residue. In closed tube, gives water on heating—decrepitates violently, and breaks up into brilliant crystalline plates, which are intense bluish-green by transmitted light. Soluble in dilute HCl and H_2SO_4, is oxidised and dissolved by HNO_3, perfectly insoluble in glacial acetic acid. Its formula is given as $7FeO, 2P_2O_5, 9H_2O$ the mean of various analyses being as follows:—

FeO	=52·76 per cent.
P_2O_5	=30·11 ,,
H_2O	=16·98 ,,
	99·85

The mineral is oblique; full details of the crystalline form as determined by Mr. Maskelyne are given, from which we copy the figures of crystals and the stereographic projection given in plate V.

According to Mr. Maskelyne the elements of the crystals are as follows,—

$$101 \cdot 100 = 42^\circ\ 24\tfrac{1}{2}'$$
$$111 \cdot 010 = 36^\circ\ 21'$$
$$101 \cdot 001 = 37^\circ\ 2\tfrac{1}{2}'$$

consequently the ratios of the axes are:—

$$a : b : c :: 1 : 0{\cdot}4389 : 0{\cdot}8932$$

and the inclination of the clinodiagonal on the principal axis is 79° 27′.

There is a very easy and perfect cleavage parallel to the faces 001 *(c)*, and a much less easy one parallel to the faces of the form 100 *(a)*. The following faces are also represented in figures 1 to 6, plate V, viz.:—

$q=111$, $q'=11\bar{1}$, $m=110$,
$d=101$, $k=201$, $t=201$,
$l=011$, $2=112$

The following angles between normals to the various faces are selected from Mr. Maskelyne's account of the crystals:—

001	$\bar{1}11$	$=c\,q=$	68° 54′
00$\bar{1}$	$\bar{1}11$	$=c'\,q=$	
$\bar{1}11$	$11\bar{1}$	$=q\,q'=$	63 24
100	001	$=a\,c=$	79 27
100	111	$=a\,q=$	107 48
100	110	$=am=$	65 55½

J. H. C.

PILINITE (A. VON LASAULX, *N. Jahrbuch f. Min.*, 1876, 353=368) occurs in cavities with calcite in the granite of Striegau as a felt-like aggregation of extremely fine colorless flexible needles, having the appearance of elongated rhombic prisms with perfect transverse cleavage. Fusible very easily, and with intumescence to a clear glass in a Bunsen flame. In matrass, gives off water. Sp. gr. at 15° C=2 263. Composition as below :—

SiO^2 =	55·70
Al_2O_3, Fe_2O_3	18·64
CaO	19·51
Li_2O	1·18
MgO, Na_2O, K_2O	traces
H_2O	4·97
	100·00

J. H. C.

ROSCOELITE (F. GENTH, *Chem. News* xxxiv, 78-80), occurs in California in dark clove-brown to greenish-brown scales, sometimes in stellate groups having a pearly lustre. Sp. gr=2·938. BB is fusible to a black glass; with micro, gives a dark-yellow bead in OF; and an emerald green bead in RF, and leaves a skeleton of silica. Is only slightly acted upon by acids at ordinary pressure, but if heated in a sealed tube with dilute sulphuric acid to 180° C, it yields a deep bluish-green solution, leaving white pearly scales of silica.

The composition is given as follows :—

SiO_2	47·69
Al_2O_3	14·10
FeO	1·67
MgO	2·00
CaO	trace
Na_2O (trace Li_2O)	0·19
K_2O	7·59
V_6O_{11}	22·02
Loss on ignition	4·96
Insol., Gold, &c.	[0·85]
	100·22

J. H. C.

Psittacinite (F. Genth, *Chem. News*, xxxiv, 78-80), occurs at several mines in the Silver Star district, Montana, in very thin mammillary, botryoidal, or pulverulent coatings of a siskin-green to olive-green color. BB fuses readily to a black shining mass, and gives with fluxes reactions for vanadium lead and copper. Soluble in dilute nitric acid, yielding on evaporation a red mass.

The following analyses shew its composition :—

	a.	*b.*	*c.*	*d.*	*e.*
PbO	41·36	50·17	42·89	27·12	42·38
CaO	14·34	16·66	14·72	9·75	15·03
V_2O_5	14·64	19·05	15·87	9·96	15·77
H_2O	7·42	not det.	not det.	not det.	7·25
SiO_2	15·13		10·10		15·57
Al_2O_3	1·29		3·83		
Fe_2O_3	2·72	7·60	2·19	4·84	4·00
MgO	not det.		0·65		
CaO	not det.		0·15		

J. H. C.

Melinophane.—This mineral is said by E. Bertrand (*Compt. rend.*, lxxxiii, 71) to belong to the rhombic system and not the tetragonal or hexagonal as hitherto stated.

J. H. C.

Lievrite (J. Emerson Reynolds, *Phil. Mag.*, *April*, 1877).—A fine crystal from Elba, recently analysed by Mr. Wm. Early, yielded the following results :—

SiO_2	29·93	per cent.
FeO	31·83	,,
Fe_2O_3	20·16	,,
MnO	3·02	,,
CaO	13·71	,,
MgO	·30	,,
Al_2O_3	·36	,,
K_2O	·20	,,
Na_2O	·29	,,
H_2O	·42	,,
	100·22	

The formula may therefore be given as R_2O_3, 6RO, $4SiO_2$ where 6RO=4 (Fe, Mn) O+2 CaO nearly, neglecting the small amount of alkalies, and regarding the water as accidental.

J. H. C.

FRANKLANDITE (J. EMERSON REYNOLDS, *Phil. Mag., April*, 1877).—This new mineral, from Peru, consists of a felted mass of long thin interlaced fibres, which are white and silky. H not greater than 1; G=1·65. Easily fused, first losing much water. Taste slightly saline, then somewhat alkaline, slightly soluble in water, easily and almost completely dissolved by dilute HCl or HNO_3. The formula assigned is $2Na_2O$, $2CaO$, $6B_2O_3$, $15H_2O$, the analysis being as follows:—

	EXPERIMENT.			THEORY.
	1	2	3	
B_2O_3 =	43·76	41·81	—	43·61
CaO	12·10	—	11·94	11·63
Na_2O	12·37	—	—	12·87
H_2O	27·92	—	27·66	28·04
(NaK) Cl = 2·41, $CaSO_4$ + 2aq = 1·44	3·85			
	100·00			96·15

The mineral is therefore near to Ulexite

J. H. C.

PEGANITE, FROM ARKANSAS (*Amer. Jour. of Sc.*, ALBERT H. CHESTER). This is shewn to be identical with the *variscite* of Breithaupt, and very near to the *callais* (*callainite*) of Damone.

J. H. C.

HEUBACHITE (*N. Jahr. f. Min.*) is a natural hydrated oxide of cobalt and nickel discovered by Prof. F. Sandberger, at St. Auton.

C. L. N. F.

GRAPHITE *(from the Imper. Geolog. Instit., Vienna, Meeting of Feb.* 20, 1877.)—Mr. J. Szombathy, by microscopical investigation, has recognized in a specimen of Siberian graphite many traces of cellular structure analagous to that of living plants. He infers from this a high probability that graphite had its origin in a vegetable substance.

T. R. J.